

# Wisconsin Groundwater Coordinating Council

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Executive Summary:  
Fiscal Year 2014

## REPORT TO THE LEGISLATURE



### **2014 GROUNDWATER COORDINATING COUNCIL MEMBERS**

Department of Natural Resources – **Russ Rasmussen, Chair**  
Department of Agriculture, Trade & Consumer Protection – **John Petty**  
Department of Safety & Professional Services – **Awaiting appointment**  
Department of Health Services - **Henry Anderson, MD**  
Department of Transportation - **Dan Scudder**  
Geological and Natural History Survey (State Geologist) - **James Robertson**  
Governor's Representative – **George Kraft**  
University of Wisconsin System – **James Hurley**

### **SUBCOMMITTEES**

#### **Research & Monitoring**

Geological and Natural History Survey - **Ken Bradbury** (Co-Chair) \*, **Madeline Gotkowitz\***, and **Bill Bristoll**  
Department of Natural Resources –**Bill Phelps\***(Co-Chair), and **Shaili Pfeiffer**  
Department of Agriculture, Trade and Consumer Protection - **Jeff Postle\*** and **Rick Graham\***  
Department of Safety and Professional Services – **Ross Fugill\*** and **Jon Heberer\***  
Department of Health Services - **Robert Thiboldeaux\***and **Ryan Wozniak\***  
University of Wisconsin System - **Paul McGinley\***, **Maureen Muldoon\***, **Tim Grundl\***, and **Trina McMahon\***  
U. S. Geological Survey - **Randy Hunt\***, **Mike Fienen\***, and **Cheryl Buchwald**  
Center for Watershed Science and Education - **George Kraft\*** and **Dave Mechenich**  
Natural Resources Conservation Service - **Tim Weissbrod\***

\* Member of Standing Joint Solicitation Work Group

#### **Outreach & Partnership**

Center for Watershed Science and Education - **Kevin Masarik** (Co-Chair)  
Department of Natural Resources – **Mary Ellen Vollbrecht** (Co-Chair)  
University of Wisconsin System –**Maira Harrington**  
Department of Agriculture, Trade and Consumer Protection –**Steve Martin**  
Department of Safety and Professional Services - **Thomas Braun**  
Department of Health Services – **Anke Hildebrandt**  
Geological and Natural History Survey - **Dave Hart** and **Carol McCartney**  
Department of Transportation - **Bob Pearson**  
State Laboratory of Hygiene –**Jeremy Olstad**  
U. S. Geological Survey – **Marie Peppler**  
Natural Resources Conservation Service - **Tim Weissbrod**  
Association of Wisconsin Regional Planning Commissions – **Eric Fowle**  
Wisconsin Rural Water Association – **Andrew Aslesen**  
Wisconsin Water Association - **Nancy Quirk**  
Wisconsin Water Well Association – **Cindy Denman**



## State of Wisconsin \ GROUNDWATER COORDINATING COUNCIL

Scott Walker, Governor

101 South Webster Street  
Box 7921  
Madison, Wisconsin 53707

Russ Rasmussen,  
Council Chair  
DNR

August 29, 2014

To: The Citizens of Wisconsin

The Honorable Governor Scott Walker

Senate Committee on Environment and Natural Resources

Assembly Committee on Natural Resources

Secretary Mark Gottlieb - Department of Transportation

Secretary Dave Ross - Department of Safety and Professional Services

Secretary Ben Brancel - Department of Agriculture, Trade & Consumer Protection

Secretary Kitty Rhoades - Department of Health Services

Secretary Cathy Stepp - Department of Natural Resources

President Ray Cross - University of Wisconsin System

State Geologist James Robertson - Geological and Natural History Survey

James Robertson  
WGNHS

John Petty  
DATCP

Henry Anderson, MD  
DHS

James Hurley  
UWS

Dan Scudder  
DOT

George Kraft  
Governor's Rep.

The Groundwater Coordinating Council (GCC) is pleased to provide its 2014 Report to the Legislature. The GCC was formed in 1984 to help state agencies coordinate non-regulatory activities and exchange information on groundwater. For 30 years, the GCC has been a model for interagency coordination and efficiency among state agencies, local and federal government, and the university. It is one of the few groups in the nation to effectively coordinate statewide groundwater efforts from an advisory position.

The level of coordinating effort and investment in groundwater is particularly appropriate as Wisconsin depends so heavily on groundwater for its drinking water. Wisconsin also relies on groundwater to irrigate crops, water cattle, and process a wide variety of foods, as well as feed trout streams and spring-fed lakes - all of which are vital to our state economy. New challenges and new ideas continue to warrant the GCC's collaborative approach.

This [on-line report](#) summarizes and links to information on the GCC and agency activities related to groundwater protection and management in FY14 (July 1, 2013 to June 30, 2014). Search "GCC" on [dnr.wi.gov](http://dnr.wi.gov) to find the full report. Click on the rotating cover graphics to see indicators of the condition of Wisconsin groundwater, our current uses and the state of our groundwater information. Click on the picture tabs for chapters of the report, beginning with the GCC's recommendations titled *Directions for Future Groundwater Protection*. The Executive Summary is attached.

We hope you will find this report to be a useful reference in protecting Wisconsin's priceless groundwater supply.

Sincerely,

Russ Rasmussen, Chair  
Groundwater Coordinating Council

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***PURPOSE OF THE GCC AND ANNUAL REPORT***

In 1984, the Legislature enacted 1983 Wisconsin Act 410, Wisconsin's Comprehensive Groundwater Protection Act, to improve the management of the state's groundwater. The Groundwater Coordinating Council (GCC) was created and is directed by s. 160.50, Wis. Stats., to "serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management. The Groundwater Coordinating Council shall advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater, including, but not limited to, agency budgets for groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities and the appropriation and allocation of state funds for research."

The GCC is required by s. 15.347, Wis. Stats., to prepare a report which "summarizes the operations and activities of the council..., describes the state of the groundwater resource and its management and sets forth the recommendations of the council. The annual report shall include a description of the current groundwater quality of the state, an assessment of groundwater management programs, information on the implementation of ch. 160, Wis. Stats., and a list and description of current and anticipated groundwater problems." This report is due each August. The purpose of this report is to fulfill this requirement for fiscal year 2014 (FY14). The report is an interactive web-page with links to extensive supporting information.

The GCC's role in facilitating inter-agency coordination includes the exchange of information regarding Wisconsin's Comprehensive Groundwater Protection (Act 1983 Wisconsin Act 410), Wisconsin's Groundwater Protection Act (2003 Wisconsin Act 310), the Great Lakes Compact (2007 Wisconsin Act 227), the federal Safe Drinking Water Act's Wellhead and Source Water Protection provisions, and many other programs.

***GROUNDWATER COORDINATION ACTIVITIES***

In addition to the council of agency leaders, the GCC is authorized to create subcommittees on "the subjects within the scope of its general duties...and other subjects deemed appropriate by the Council." See a list of GCC members and subcommittees on the inside cover of this executive summary.

The GCC and its subcommittees regularly bring together staff from over 15 different agencies, institutions and organizations to communicate and work together on a variety of research, monitoring and data management, educational, and planning issues. A strong network among GCC and subcommittee members leads to coordination across agency lines on a variety of groundwater-related issues. These activities regularly avoid duplication, create efficiencies, and provide numerous benefits to Wisconsin's taxpayers.

***Coordination of Groundwater Research and Monitoring Program***

The GCC is directed to "advise the Secretary of Administration on the allocation of funds appropriated to the Board of Regents of the University of Wisconsin under s. 20.285(1)(a) for groundwater research." Since 1992, a joint solicitation process has facilitated selection and funding of sound scientific research and monitoring to answer state priority needs.

The GCC, the UWS, DNR and the Groundwater Research Advisory Council (GRAC) again collaborated on the annual solicitation for groundwater research and monitoring proposals as specified in the Memorandum of

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Understanding. After a multi-agency effort spearheaded by the UW Water Resources Institute, the GCC approved the FY 15 Joint Solicitation for Proposals.

A total of 22 project proposals were received. A comprehensive review process including the GRAC, the GCC's Monitoring & Research Subcommittee, and outside technical experts resulted in recommendations that were used by the UWS and DNR in deciding which groundwater-related proposals to fund. The process resulted in the selection of eight new projects for funding for FY15, three by UWS and five by DNR. The GCC approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats., and a letter to this effect was sent to the UWS President and the Department of Administration. [Projects funded in FY 14](#) and [Projects selected for funding in FY 15](#) are available online, and all Wisconsin state-funded groundwater research and monitoring projects are shown at this link:

<http://dnr.wi.gov/topic/groundwater/documents/GCC/MonitoringResearch/AllProjects.pdf>

The UW Water Resources Institute (WRI) provides access to [summaries and reports](#) of GCC-facilitated groundwater research, as well as cataloging all WRI research reports into WorldCat and MadCat, two library indexing tools that provide both worldwide and statewide access to this research. The Water Resources Library has partnered with UW Libraries' Digital Collections Center to digitize and post UWS and DNR final project reports. As a result of this partnership, full-text reports are also available through the [UW Ecology and Natural Resources Digital Collection](#). In 2013, progress continued in locating older final reports and summaries for Internet accessibility.

### Information and Outreach Activities

For the 14<sup>th</sup> year in a row, three groundwater workshops for teachers were taught jointly by GCC Outreach and Partnership Subcommittee members from the DNR, WGNHS and the Center for Watershed Science and Education (CWSE) at Stevens Point. In January and February, educators from 24 schools and nature centers took part in the workshops held at Mount Horeb, Eau Claire, and Green Bay. The workshop leaders instructed teachers on using a groundwater sand-tank model and provided additional resources to incorporate groundwater concepts into their classroom. Educators who attended the workshops received a free model. With funding from a U.S. Environmental Protection Agency (EPA) wellhead protection grant, over 275 groundwater models have been given to schools and nature centers since 2001 and nearly 550 educators have received hands-on training in using the model effectively. Educators are regularly surveyed to promote continued use and evaluate educational benefits.

### Other Coordination Activities

The GCC continued to promote communication, coordination, and cooperation between the state agencies through its quarterly meetings. In addition to identifying collaboration opportunities, making decisions about research, and guiding report development, the GCC received briefings and discussed a variety of current topics at its FY14 meetings:

- Climate-change and rain-induced health risks
- Water use for agricultural irrigation
- Ecological limits of hydrologic alteration in Wisconsin streams
- Origins and distribution of strontium in Wisconsin groundwater
- Demonstration of the Dane County Groundwater Model

More information on the coordinating efforts of the GCC can be found in the FY14 GCC meeting minutes. Through these activities, the GCC plays an important role in ensuring agency coordination, increasing efficiency, avoiding duplication, and facilitating the effective functioning of state agencies in activities related to

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groundwater protection and management. As a result, groundwater is better protected, which benefits public health, sustains our economy, and preserves Wisconsin's natural resources for future generations.

**SUMMARY OF AGENCY GROUNDWATER ACTIVITIES**

State agencies and the University of Wisconsin System addressed numerous issues related to groundwater protection and management in FY14. Detailed discussions of the groundwater activities of each agency can be found at the agency activities tab in the [on-line report](#).

**CONDITION OF THE RESOURCE: Groundwater Quality**

Major groundwater quality concerns in Wisconsin are summarized below and detailed in the [on-line report](#).

**Nitrate**

Nitrate is Wisconsin's most widespread groundwater contaminant and is increasing in extent and severity. Nitrate levels in groundwater above 2 milligrams per liter (mg/L) indicate a source of contamination such as agricultural or turf fertilizers, animal waste, septic systems, and wastewater. While nitrate in agricultural use has benefits such as larger crop yields, high concentrations in groundwater lead to public health concerns. At least 90% of total nitrate inputs into our groundwater originate from agricultural sources.

In total, 56 public water supply systems exceeded the nitrate drinking water standard of 10 mg/L in 2013 requiring them to post notices, provide bottled water, replace wells, install treatment, or take other corrective actions. Concentrations of nitrate in private water wells have also been found to exceed the standard. A 2007 DATCP survey estimated that 9 % of private wells exceeded the 10 mg/L enforcement standard for nitrate. GCC member agencies are working on multiple initiatives related to reducing the risk of high nitrate levels in groundwater and drinking water.

**Bacteria, viruses and other pathogens**

Bacteria, viruses, and other pathogens often occur in areas where the depth to groundwater is shallow, in areas where soils are thin, or in areas of fractured bedrock. These agents can cause acute illness and result in life-threatening conditions for young children, the elderly, and those with chronic illnesses. In one assessment (Warzecha et.al., 1994), approximately 23% of private well water samples statewide tested positive for total coliform bacteria, an indicator species of other biological agents. Approximately 3% of these wells tested positive for *E. coli*, an indicator of water borne disease that originates in the mammalian intestinal tract.

Viruses in groundwater are increasingly a concern as new analytical techniques have detected viral material in private wells and public water supplies. Research conducted at the Marshfield Clinic indicates that 4-12% of private wells contain detectable viruses. Other studies showed virus presence in four La Crosse municipal wells, in the municipal wells and wastewater system in Madison, and in five shallow municipal wells serving smaller communities.

Public and private water samples are not regularly analyzed for viruses due to the high cost of the tests. The presence of coliform bacteria has historically been used to indicate the water supply is not safe for human consumption. However, recent findings show that coliform bacteria do not always correlate with the presence of enteric viruses. GCC member agencies are involved with research and risk reduction measures on this issue.

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### **Volatile Organic Compounds (VOCs)**

Sources of VOCs in Wisconsin's groundwater include landfills, underground storage tanks, and hazardous substance spills. Thousands of wells have been sampled for VOCs and about 60 different VOCs have been found in Wisconsin groundwater. Trichloroethylene is the VOC found most often in Wisconsin's groundwater.

### **Pesticides**

Pesticide contamination in groundwater results from field applications, pesticide spills, misuse, or improper storage and disposal. Pesticide metabolites are related chemical compounds that form when the parent pesticide compounds break down in the soil and groundwater. The most commonly detected pesticide compounds in Wisconsin groundwater are atrazine and metabolites of atrazine, alachlor, and metolachlor.

In 2011, DATCP reported on the results of its [\*2010 Survey of Weed Management Practices in Wisconsin's Atrazine Prohibition Areas \(PA\)\*](#). The main purpose of this survey was to identify differences in herbicide use and other weed control practices inside and outside of Wisconsin's atrazine prohibition areas. Survey results suggest that although many corn growers would like the option to use atrazine in a prohibition area, they have adapted to growing corn without it. Half of the respondents indicated that they do not find it more difficult to control weeds in a PA without atrazine.

The DATCP pesticide database contains test results from nearly 13,000 wells tested with the immunoassay screen for atrazine and over 5,500 wells tested by the full gas chromatography method. In 2013, DATCP produced a map showing locations and atrazine levels of private drinking water wells tested for atrazine in the state. The immunoassay screen results showed that about 40 percent of private wells tested have atrazine detections, while about 1 percent of wells contained atrazine over the groundwater enforcement standard of 3 µg/L. The approximately 5,500 wells tested by full gas chromatography showed detectable levels of atrazine in about 38% of the wells and levels over the enforcement standard in about 8% of the wells. The enforcement standard for atrazine includes atrazine and three of its metabolites.

### **Radionuclides**

Naturally-occurring radionuclides, including uranium, radium, and radon, are an increasing concern for groundwater quality, particularly in the Cambro-Ordovician aquifer system in eastern Wisconsin. The water produced from this aquifer often contains combined radium activity in excess of 5 pCi/L and in some cases in excess of 30 pCi/L. Historically, about 80 public water systems exceeded a radionuclide drinking water standard, causing these communities to search for alternative water supplies or treatment options. The vast majority of these systems are now serving water that meets the radium standard. The DNR continues to work with the remaining water systems to ensure that they develop a compliance strategy and take corrective actions.

### **Arsenic**

Naturally occurring arsenic has been detected in wells throughout Wisconsin. DNR historical data show that about 4,000 public wells and over 3,000 private wells have detectable levels of arsenic. About 10% of these wells exceed the federal drinking water standard of 10 µg/L. Although arsenic has been detected in well water samples in every county in Wisconsin, the problem is especially prevalent in northeastern Wisconsin where increased water use has likely released arsenic from rocks and unconsolidated material into the groundwater. GCC member agencies and partners continue to proactively address arsenic concerns through well drilling advisories, health studies, well testing campaigns, and studies aimed at improving geological understanding and developing practical treatment technologies.

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***CONDITION OF THE RESOURCE: Groundwater Quantity***

Groundwater quantity conditions are summarized below and detailed in the [on-line report](#) .

Groundwater is available in sufficient amounts throughout most of Wisconsin to provide adequate water supplies for most municipal, industrial, agricultural, and domestic uses. What is frequently missed is that groundwater pumping lowers water levels in aquifers and connected lakes, wetlands, and streams; and diverts flow to surface waters where groundwater would have discharged naturally. The amount of water level lowering and flow diversion is a matter of degree. At certain amounts of pumping in an area, streams, lakes, and wetlands can dry up and aquifers can be perilously lowered.

Groundwater pumping shows a continued long term increase. Numbers of high capacity wells, especially in the Central Sands region of the state (parts of Portage, Waushara, Waupaca, Adams, and Marquette Counties), indicates pumping amounts will continue to expand.

Groundwater pumping issues have arisen in multiple regions of Wisconsin. Large scale drawdowns of the confined aquifer have been documented in the Lower Fox River Valley and southeastern Wisconsin. Surface water impacts have been well-documented in the Wisconsin Central Sands and Dane County. These impacts have included the drying of lakes and streams.

***BENEFITS OF MONITORING AND RESEARCH PROJECTS***

The GCC provides consistency and coordination among state agencies in funding Wisconsin's Groundwater Research and Monitoring Program to meet state agency needs. Approximately \$17 million has been spent over 22 years by DNR, UWS, DATCP, and Commerce more than 400 different projects selected to advance understanding and management of groundwater in Wisconsin.

Projects funded have provided valuable information regarding the Wisconsin's groundwater resources, helped evaluate existing programs, increased the knowledge of the movement of contaminants in the subsurface, and developed new methods for groundwater evaluation and protection. While the application of the results is broad, some areas where the results of state-funded groundwater research and monitoring projects have been successfully applied to groundwater problems in Wisconsin include:

- Detection and monitoring of microbiological contaminants
- Arsenic monitoring and research in Northeastern Wisconsin
- Groundwater movement in shallow carbonate rocks
- Developing new tools for groundwater protection
- Prevention and remediation of groundwater contamination
- Groundwater drawdown
- Comprehensive planning
- Rain garden design and evaluation
- Methylmercury formed in groundwater
- Atrazine in groundwater
- Groundwater monitoring at solid waste disposal sites



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See the "Benefits from Projects" tab in the [on-line report](#) for more information on how project results are used to improve management of the state's groundwater resources.

**RECOMMENDATIONS: DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION**

The GCC is directed by statute to include in its annual report a "list and description of current and anticipated groundwater problems" and to "set forth the recommendations of the Council" (s. 15.347(13)(g), Wis. Stats.). In this section, the GCC identifies its recommendations for future groundwater protection and management needs to state agencies, the Governor, the Legislature, and the citizens of Wisconsin. These recommendations include top priorities of immediate concern, on-going efforts that require continued support, and emerging issues that will need to be addressed in the near future.

**Priority Recommendations**

**Evaluate the occurrence of viruses and other pathogens in groundwater and groundwater-sourced water supplies and develop appropriate response tools.** Recently, viruses and other microbial pathogens have been found in municipal and domestic wells, challenging previous assumptions about their occurrence. The legislature and agencies should support research to refine our understanding of pathogens in groundwater and their threat to human health. Agencies should also work with partners to increase awareness of the risks and long-term costs of waste disposal choices. Background on the issue and the rationale for the recommendation are found in the report.

**Implement practices that protect groundwater from nitrate and other agricultural contaminants (pesticides, pharmaceuticals, and their degradates).** Nitrate contamination that approaches and exceeds unsafe levels in drinking water is a common occurrence in Wisconsin, posing an acute risk to infants and women who are pregnant, a possible risk to the developing fetus during very early stages of pregnancy, and a chronic risk of serious disease in adults. In addition, pesticides are estimated to be present in one-third of private drinking water wells in Wisconsin. Areas of the state with a higher intensity of agriculture generally have higher frequencies of detections of pesticides and nitrate. Agencies should develop and evaluate a strategy to promote practices that lead to efficient use of nitrogen and careful or reduced use of pesticides in order to protect drinking water sources. The legislature should support the implementation of these practices with appropriate incentives.

**Support the sustainable management of groundwater quantity and quality in the state to ensure that water is available to be used which will protect and improve our health, economy, and environment now and into the future.** This includes:

- Supporting an inventory of information on the location, quantity, and uses of the state's groundwater
- Supporting targeted research and modeling on the impact of groundwater withdrawals on other waters of the state
- Supporting proactive regional groundwater planning in areas with limited groundwater resources where increased groundwater use and development/population growth pressures are leading to water availability and sustainability issues

**Ongoing Recommendations**

Without attention to the ongoing recommendations, Wisconsin cannot address the priority recommendations or begin to understand emerging issues.

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**Support implementation of the Statewide Groundwater Monitoring Strategy.** Chapter 160 of the Wisconsin Statutes requires the DNR to work with other agencies and the GCC to develop and operate a system for monitoring and sampling groundwater to determine whether harmful substances are present (s. 160.27, Wis. Stats.). The strategy has been incorporated into the DNR Water Monitoring Strategy, but needs are constantly evolving as new problems emerge. For example, food processors, homeowners, municipalities, and well drilling contractors need more information about the origin and extent of naturally occurring contaminants such as arsenic, other heavy metals, acidic conditions, sulfate, total dissolved solids, radium, and uranium. Wisconsin should improve the accessibility of current data and continue to encourage research efforts that will provide information for addressing these issues. State agencies, the university, and federal and local partners should continue to implement and modify this strategy to efficiently meet monitoring objectives.

**Continue to catalog Wisconsin's groundwater resources.** Management and protection of Wisconsin's groundwater resources requires publically-accessible and up-to-date data in order to foster informed decisions, not only on state policy matters but also on business siting or technology investments. State agencies and the University should continue to collect, catalog, share, and interpret new data about Wisconsin's groundwater so that it can be used by health care providers and people seeking business locations, as well as homeowners and local governments.

**Continue to support applied groundwater research.** Numerous years of state budget cuts and increased costs have reduced the number of groundwater research projects that are funded each year. Continued cuts will hamper the State's ability to address critical groundwater monitoring and research needs in the future. Research is necessary to identify and test cost-effective groundwater protection strategies that can prevent groundwater problems before they need to be remediated at a much greater cost. State agencies and the Legislature should work to restore adequate funding to answer the key groundwater questions facing Wisconsin water suppliers and to seek partnerships to leverage additional research support.

**Emerging Issues**

**Frac sand mining.** Since 2010, unprecedented growth of the frac sand mining and processing industry has occurred in West-Central Wisconsin and is expected to grow for another decade. The potential impact of this industry on groundwater resources has not been comprehensively evaluated, which would be the first step to avoid problems and plan for restoration. Wisconsin agencies and the legislature should support research and field investigations to understand how this industry might impact groundwater. The agencies should partner with industry and local governments to rapidly develop and adapt site analysis and best-management practices for mining and long-term site restoration.

**Metallic mining.** During 2011, a proposed iron mine in northern Wisconsin generated significant public discussion. Several lead, zinc, and copper mines have also been proposed around the state. These proposed mines are located in sparsely-populated regions where background information on groundwater resources is often incomplete. Workers, residents, and mining operators will require substantial supplies of water for drinking and processing ore. The state should support background data collection and groundwater assessments to inform both public debate and technical discussions about potential mining operations.

**Livestock industry expansion and concentration.** Since 2010, many animal feeding operations that house thousands of animals have been sited or proposed in Wisconsin. These operations require large quantities of groundwater and must also dispose of large amounts of animal waste. Wisconsin agencies should develop better tools for measuring water quality and quantity impacts in and around these operations to evaluate the

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need for establishing tighter conditions on future permits for similar operations. It is important for agencies to develop partnerships with industry for outreach and development of policies and research that allow for effective siting and efficient operation of these facilities, while still protecting groundwater quality and quantity.

**Evaluate potential impacts of climate change on Wisconsin's groundwater.** Climate change will likely increase the frequency and severity of weather patterns that may produce unprecedented flooding or drought conditions. As a result, land and water use patterns may also change and affect the groundwater supply. These may include biological or chemical contamination issues, or an increased demand for groundwater by agricultural, municipal, and commercial users. More work is needed to determine the range of possible climates in Wisconsin's future. Work is also needed on feedback mechanisms between climate and groundwater to fully characterize possible changes to Wisconsin's groundwater resource. This research will help identify drought response and long-term management strategies for Wisconsin's groundwater supply.